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PATENT APPLICATION
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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<u>MELISSA C. SMITH</u> (SENDER'S PRINTED NAME)	 (SIGNATURE)

Box Patent Application
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Enclosed for filing is a patent application under 37 CFR 1.53(b) of: Roy Chrisop, Gary Lin Gaebel and Larry Alan Westerman entitled METHOD AND APPARATUS FOR INTELLIGENT SPEAKER

This application is a [] continuation, [] divisional, [] continuation-in-part of prior application Serial No. _____.

Enclosures:

- ☒ Specification (pages 1-5); claims (pages 6-7); abstract (page 8)
- ☒ 2 sheets of informal drawings
- ☒ Declaration or Combined Declaration and Power of Attorney
 - ☒ Newly executed
 - ☐ Copy from a prior application (37 CFR 1.63(d))
 - ☐ Incorporation by Reference--The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
 - ☐ Deletion of Inventors (signed statement attached deleting inventor(s) named in the prior application (37 CFR 1.63(d)(2) and 1.33(b))
- ☒ Power of Attorney
- ☒ Assignment with cover sheet

09593924-061300

- ☐ Certified copy of priority document:
☐ Information Disclosure Statement with Form PTO 1449
☐ Copies of references listed on attached Form PTO-1449
☐ Preliminary Amendment

CLAIMS AS FILED				
For	Number Filed	Number Extra	Rate	Basic Fee \$690.00
Total Claims	17-20	0	x \$ 18.00 =	
Independent Claims	3-3	0	x \$ 78.00 =	
Multiple Dependent Claim Fee			x \$260.00 =	
TOTAL FILING FEE				\$690.00

- ☐ Cancel in this divisional application original claims _____ of the prior application Serial No. _____ before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)

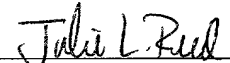
☒ A check in the amount of \$730.00 to cover ☒ filing fee (\$690) and ☒ assignment recordal fee (\$40) is enclosed.

☒ Any deficiency or overpayment should be charged or credited to deposit account number 13-1703. A duplicate copy of this sheet is enclosed.

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Respectfully submitted,

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METHOD AND APPARATUS FOR INTELLIGENT SPEAKER
BACKGROUND

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1. Field

This invention relates to audio systems, more particularly to determining speaker characteristics and matching of audio system components.

2. Background

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High-end audio systems typically include various signal production components, such as tuners, CD players, tape decks, and turntables, amplifying components such as receivers and amplifiers, and sound generation elements, usually various configurations of speakers. Connoisseurs of audio systems often buy the components from various manufacturers, or change components of the same manufacturer over the system lifetime.

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High-quality equipment available today has commensurately high-quality component signal levels, with broad audio bandwidth and ultra-low distortion. Interfaces exist between the signal generation equipment and the amplification equipment. However, the interface between the amplification equipment and the sound generation equipment is not as well characterized. Current state-of-the-art speakers have nominal impedances of 4 or 8 ohms, matching the output impedance of the amplifier. Beyond that, no general standardization exists.

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Speaker characteristics can be derived in several ways. The characteristics can include such performance aspects as maximum power handling capacity, impedance profile, and equalization requirements. Users typically adjust for these characteristics manually, which can be subjective and imprecise, as well as time-consuming. These adjustments typically do not account for the maximum power capacity, except for the manual volume control. Overpowering the speaker can damage or ruin it, resulting in a 'blown' speaker.

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Methods have been suggested to compensate for this lack of speaker characterization in audio systems. For example, US Patent No. 4,592,088, issued May 27, 1986 discloses a method of placing a microphone within a speaker enclosure or housing. The output of the microphone is fed back to the amplifier, providing control of the amplifier output in view of

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the speaker output. However, this approach relies upon the quality of the microphone as well as the extra interface between microphone and amplifier.

In another example, found in US Patent No. 5,818,948, issued October 6, 1998, the speaker is powered and communicates along a USB interface. The USB controller receives the audio data along this bus. It also detects when there is no data and manages power to the speakers based upon their status of receiving or not receiving any signals. However, there are no control communications with regard to the speaker characteristics.

Another example can be found in US Patent No. 5,532,556, issued July 2, 1996. This disclosure includes multiplexing audio and control signals together between audio function units. The control signals do not include information about speaker characteristics, beyond their presence and their status as receiving or not receiving audio signal.

Therefore, a need exists for a method and apparatus for providing speaker characteristics along already-established interfaces in audio systems.

SUMMARY

One aspect of the invention is a speaker system having speaker hardware and a communications module. The communications module transmits information from the speaker system about the speaker characteristics. In one embodiment of the invention, the communications module is powered by a carrier signal. A high-pass filter passes the carrier signal to a rectifier, which provides power to the communications module. The communications module then transmits the speaker characteristic information along the connection between the speaker system and the amplifier.

Another aspect of the invention is a method for operating a speaker system having intelligence. A carrier signal is generated by an amplifier and sent to a speaker system connected to the amplifier. The carrier signal is used to provide power to a communications module that transmits information to the amplifier. The transmission continues until the carrier signal is no longer present. An optional step includes transmitting information from the amplifier to the speaker. The connection may be wired or wireless, the transmission format may be any standardized format, including amplitude modulation of the carrier signal, phase-shift keying, or two-tone modulation among others.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be best understood by reading the detailed description with reference to the drawing(s), wherein:

Figure 1 shows one embodiment of a block diagram of an audio system including an amplifier and speakers, in accordance with the invention.

Figure 2 shows one embodiment of a block diagram of an intelligent speaker, in accordance with the invention.

Figure 3 shows a flowchart for one embodiment of a method for communicating between a speaker and an amplifier.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Figure 1 shows an amplifier 10 connected to speakers 12a and 12b. This is merely intended as an illustration of the sound generation and amplification portions of a sound system. Typically, sound systems include a tuner/receiver, a CD player, tape deck, turntable or some other type of sound production equipment. Similarly, the speakers 12a and 12b are shown connected to the amplifier 10 through wired connections. It must be understood that the connection between the speakers and the amplifier could also be wireless. However, for purposes of discussion, and with no intention of limiting the invention, a wired connection will be assumed.

The speakers 12a and 12b of Figure 1 have several components in them other than just the speaker hardware. For that reason, they will be referred to as speaker systems. A more detailed block diagram of a speaker system 12 is shown in Figure 2. The speaker system 12 housing connects to the amplifier via connections 20a and 20b. These are shown a wired connection. If this were a wireless speaker system, there would be a wireless receiving module in place of the connections 20a and 20b. The speaker hardware, such as woofers and/or tweeters, is shown as speaker 22. The intelligence of the speaker lies in the three components of the high-pass filter 24, the rectifier 26 and the communications module 28.

The speaker system is powered by a high frequency carrier signal. High-pass filter 24 passes the high frequency signal to the rectifier 26. The rectifier 26 operates to convert the high frequency carrier to power, which is used to power the communication module 28. Communication module 28, upon receiving power, will start transmitting through the speaker

connections 20a and 20b. The transmission will send the speaker characteristics to the amplifier.

There are several methods by which the communication module can transmit to the amplifier. These include amplitude modulation of the carrier signal, phase-shift keying, and two-tone modulation. The amplifier would require a module capable of receiving this transmission and interpreting its contents. In some situations, it may be desirable for the amplifier to receive all types of transmissions from speakers, so one amplifier may be used with any type of intelligent speaker.

The communication module 28 will continue to transmit so long as there is a carrier signal. The amplifier may have a switching or polling mechanism that allows it to provide carrier signals only to those speakers with which it wants to communicate. When the amplifier has received the information, it can shut down communications by dropping the carrier signal. Without the power derived from the carrier signal, the communication module shuts down.

One embodiment of a method for operating a sound system with intelligent speakers is shown in Figure 3. The amplifier generates the carrier signal at 30. The high-pass filter will either be passing the high frequency carrier signal or not at 32. If the carrier signal is present, the power is provided to the communications module and transmission from the speaker occurs at 34. In higher-end systems, it may be desirable for the amplifier to send control signals to the speaker, other than the audio data. This would occur at 36, but this is an optional step and not necessary for practice of the invention. The transmission loop repeats until the carrier signal is no longer present. Once the carrier signal is not present at 32, the communications module shuts down at 38.

A concern in using such a communication module and the speaker connection is that the communication may affect speaker performance and degrade the quality of the system. However, some adjustments can overcome that problem. First, the high-pass filter, rectifier and communications module can be designed to present high impedance at all frequencies within the normal audio range of the speaker system. This prevents any significant load from being placed on the connection, which could significantly impact the speaker characteristics. Essentially, this renders the intelligence components of the speaker system transparent.

Another adjustment can separate the carrier signal and control data from the audio signal. The carrier signal and communication from the speaker could be handled in a separate

frequency band from the audio signal, selected so as to not have any overlap. Alternatively, the two bands could overlap, at least partially. In this situation, it may be desirable to shut down the communications module as soon as the transmission is completed, to avoid any degradation of the audio signal due to communication signal noise. The communication
5 could transpire at power up of the system, using delays in acquiring a sound production signal to allow communication from the speaker.

An advantage of the speaker with intelligence is that it allows the amplifier to have more complete information with regard to the speaker characteristics. The amplifier would have data on the maximum power handling capacity, the impedance profile and the
10 equalization requirements. For example, the speaker may have a maximum power capacity that is less than that indicated by full volume on the amplifier. The amplifier could then override any volume settings that would otherwise damage a speaker. Similarly, having more exact information than a range of impedance and the equalization requirements will allow the speaker to modulate the audio signal more precisely, resulting in better system performance.

Thus, although there has been described to this point a particular embodiment for a
15 method and structure for an intelligent audio speaker, it is not intended that such specific references be considered as limitations upon the scope of this invention except in-so-far as set forth in the following claims.

WHAT IS CLAIMED IS:

1. A speaker system operable to generate sound, comprising:
 - a) a speaker operable to generate sound in response to an audio signal; and
 - b) a communication module operable to transmit information to an amplifier in response to a carrier signal, wherein the information includes speaker characteristics.
2. The speaker system of claim 1, wherein the communication module transmits information to the amplifier across wires.
3. The speaker system of claim 1, wherein the communication module transmits information to the amplifier using a wireless connection.
4. The speaker system of claim 1, wherein the speaker system further comprises a high-pass filter and rectifier operable to derive output power from the carrier signal.
5. The speaker system of claim 1, wherein the communication module has high impedance to avoid placing a load on the speaker that would degrade system performance.
6. The speaker system of claim 1, wherein the communication module communicates via one of the group comprising: amplitude modulation, phase-shift keying, and two-tone modulation.
7. The speaker system of claim 1, wherein the information transmitted by the communication module is transmitted in a separate frequency band from the audio signal.
8. The speaker system of claim 1, wherein the information transmitted by the communication module is transmitted in a frequency band that overlaps the audio signal.
9. A method for operating a speaker system in a sound system, the method comprising:
 - a) generating a carrier signal from an amplifier to the speaker system through a connection between the amplifier and the speaker system;
 - b) rectifying power from the carrier signal in a speaker system, wherein the power is used by a communication module; and
 - c) transmitting information to the amplifier using the communication module for as long as the carrier signal is present at the speaker system.
10. The method of claim 9, the method further comprising presenting high impedance at an interface between the communication module and the speaker system connection and at all frequencies with a normal audio range of the speaker.
11. The method of claim 9, the method further comprising transmitting information from the amplifier to the speaker system.

12. The method of claim 9, wherein the transmitting information to the amplifier is accomplished using one of the group comprising: amplitude modulation; phase-shift keying; and two-tone modulation.
13. The method of claim 9, wherein the information is transmitted in a frequency band
5 separate from a frequency band used by an audio signal.
14. The method of claim 9, wherein the information is transmitted in a frequency band that overlaps a frequency band used by an audio signal.
15. A speaker system, comprising:
- a) a speaker connector operable to connect the speaker system to an amplifier;
 - 10 b) speaker hardware operable to generate sound from an audio signal received from the speaker connectors;
 - c) a high-pass filter operable to pass a high frequency carrier signal received from the speaker connector;
 - d) a rectifier operable to receive the high frequency carrier signal and convert it into a
15 power signal; and
 - e) a communications module operable to receive the power signal from the rectifier and transmit characteristics of the speaker hardware to the amplifier using the speaker connector.
16. The speaker system of claim 15, wherein the speaker connector connects the speaker
20 system to the amplifier with wires.
17. The speaker system of claim 15, wherein the speaker connector connects the speaker system to the amplifiers using a wireless connection.

FIG.1

FIG.2

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graph TD; 30[Generate Carrier Signal] --> 32{Is Carrier Present?}; 32 -- NO --> Exit(( )); 32 -- YES --> 34[Transmit from Speaker]; 34 --> 36[Transmit from Amplifier]; 36 --> 38([Shut Down Communication Module]); 38 --> 32;
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FIG.3

COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **METHOD AND APPARATUS FOR INTELLIGENT SPEAKER**, the specification of which:

- ☒ is attached hereto.
☐ was filed on _____ as Application No. _____
☐ and was amended on _____ (if applicable)
☐ with amendments through _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, Sec. 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Sec. 119 (a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Claiming Priority?	
			<input type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
_____	_____	_____		

I hereby claim the benefit under Title 35, United States Code, Sec. 119(e) of any United States provisional application listed below:

<u>Provisional Application No.</u>	<u>Filing Date</u>
_____	_____

I hereby claim the benefit under Title 35, United States Code, Sec. 120 or §365(c) of any PCT international application designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the

prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Sec. 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Sec. 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application No.) (Filing Date) (Status) (patented, pending, abandoned)

I hereby appoint the following attorneys to prosecute the application, to file a corresponding international application, to prosecute and transact all business in the Patent and Trademark Office connected therewith:

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Julie L. Reed	35,349
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

[illegible]

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COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **METHOD AND APPARATUS FOR INTELLIGENT SPEAKER**, the specification of which:

- ☒ is attached hereto.
☐ was filed on _____ as Application No. _____
☐ and was amended on _____ (if applicable)
☐ with amendments through _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, Sec. 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Sec. 119 (a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Claiming Priority?	
			<input type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
_____	_____	_____		

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_____	_____

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<u>(Application No.)</u>	<u>(Filing Date)</u>	<u>(Status) (patented, pending, abandoned)</u>
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